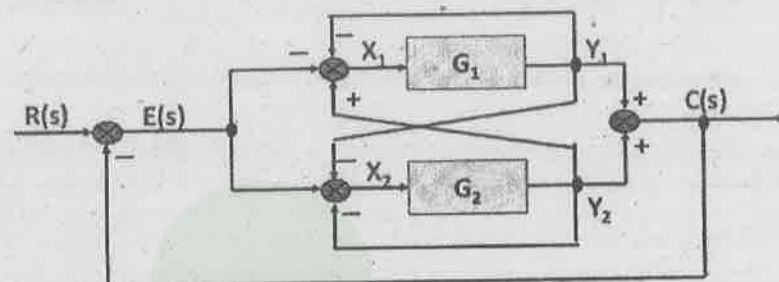


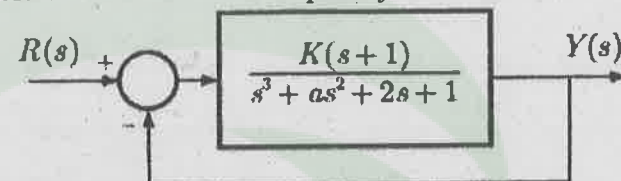
03/11/18  
FJ

PART C — (1 × 15 = 15 marks)

16. (a) (i) Determine the transfer function  $C(s)/R(s)$  for the figure shown below : (7)

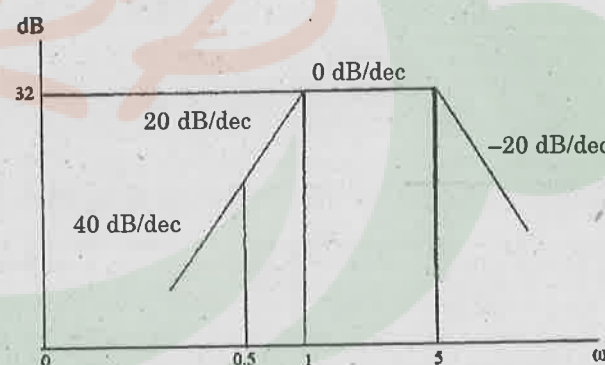


- (ii) Determine the positive values of  $K$  and  $\alpha$  so that the system shown below oscillates at a frequency of 2 rad/sec. (8)

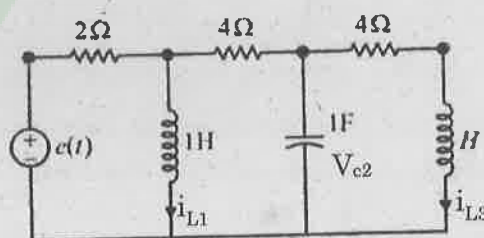


Or

- (b) (i) Determine the transfer function of the system for the magnitude plot shown below. (7)



- (ii) For the circuit shown in figure, choose state variables  $x_1, x_2, x_3$  to be  $i_{L1}(t), V_{C2}(t), i_{L3}(t)$ . (8)



Determine the state equation

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = A \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + B[e(t)].$$

Reg. No. :

**Question Paper Code : 25075**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2018.

Third Semester

Electronics and Communication Engineering

EC 8391 — CONTROL SYSTEMS ENGINEERING

(Common to Electronics and Telecommunication Engineering)

(Regulations 2017)

Time : Three hours

Maximum : 100 marks

(Provide Semilog sheet, Polar graph and ordinary graph sheet)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define closed-loop control system with a suitable example.
2. Write the force-voltage analogous of a mechanical spring and dash pot.
3. What will be the response of a first-order system with unit step input?
4. Discuss the effect of adding a pole to open loop transfer function of a system.
5. In a Bode plot of a unity feedback control system, the value of phase of  $G(j\omega)$  at the gain cross over frequency is  $-125^\circ$ . What is the phase margin?
6. Differentiate phase lead and phase lag compensator?
7. Find the range of  $K$  for stability of a closed loop system with characteristic equation  $S^4 + 8S^3 + 36S^2 + 80S + K = 0$  using Routh stability criterion.
8. The Nyquist plot of  $G(j\omega)H(j\omega)$  for a closed loop control system, passes through  $(-1, j0)$  point in the GH-plane. What is the gain margin of the system in dB?
9. List any four advantages of state – variable analysis?
10. Draw the block diagram of state space model.

PART B — (5 × 13 = 65 marks)

11. (a) Write the differential equations governing the behavior of the translational mechanical systems shown in Figure 1 and hence find  $X_1(s)$ . (13)

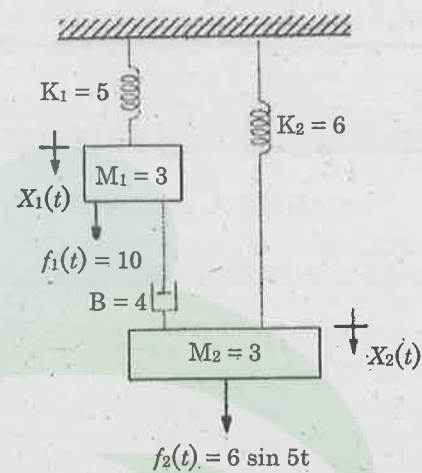


Figure 1

Or

- (b) A system is represented by signal flow graph shown in Figure 2, obtain the overall gain of the system using Mason's gain formula. (13)

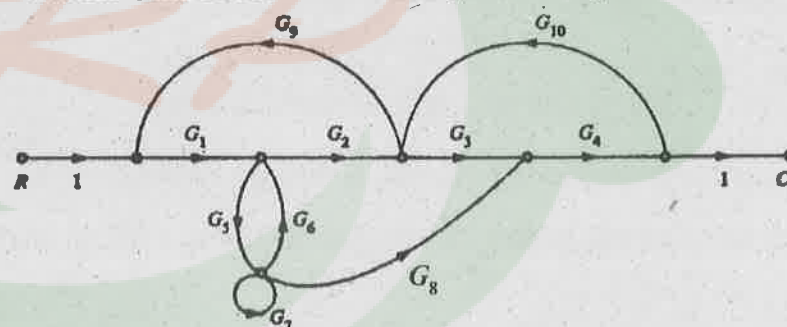


Figure 2

12. (a) (i) Consider the system shown in Figure 3, where damping ratio is 0.6 and natural undamped frequency is 5 rad/sec. Obtain the rise time  $t_r$ , peak time  $t_p$ , maximum overshoot  $M_p$ , and settling time 2% and 5% criterion  $t_s$  when the system is subjected to a unit-step input. (6)

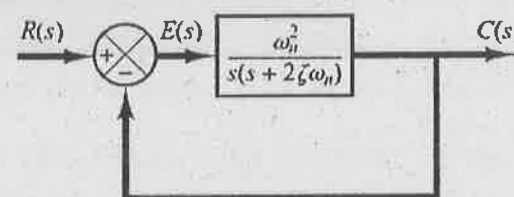


Figure 3

- (ii) Derive the expression for peak time and settling time for the underdamped second order system with unit step input. (7)

Or

- (b) (i) For a unity feedback system  $G(s) = \frac{200}{s(s+8)}$  and  $r(t) = 2t$  determine steady state error. If it is desired to reduce this existing error by 5% find the new gain of the system. (7)

- (ii) Explain in detail about PID controllers used in control systems. (6)

13. (a) The open loop transfer function with unity feedback given by  $G(s) = \frac{1}{s(1+0.1s)(1+s)}$ . From the bode plot, determine the gain crossover frequency, phase crossover frequency, gain margin and phase margin. (13)

Or

- (b) The open loop transfer function for a unity feedback system is given by,  $G(S) = \frac{K}{S(1+0.2S)(1+0.05S)}$ . Sketch the polar plot and determine the value of  $K$  so that gain margin is 18dB. (13)

14. (a) Sketch the root locus of the system whose transfer function is given by  $\frac{C(s)}{R(s)} = \frac{K}{s(s+4)(s^2+s+1)+K}$ . (13)

Or

- (b) Sketch the Nyquist plot for the following open loop transfer function is given by  $G(s)H(s) = \frac{K(1+s)^2}{s^3}$ . Determine the range of  $K$  for stability. (13)

15. (a) A system is given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \end{bmatrix} [u] \text{ with } \begin{bmatrix} x_1(0) \\ x_2(0) \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}.$$

Where  $u$  is unit step function. Find the state transition matrix and there from find the state response, i.e.,  $x(t)$  for  $t > 0$ . (13)

Or

- (b) Find the state equation and output equation for the system given by  $\frac{Y(s)}{R(s)} = \frac{s^3 + 5s^2 + 6s + 1}{s^3 + 4s^2 + 3s + 3}$ . Also check for controllability and observability. (13)